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Abstract Book

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Ring interband cascade lasers emitting in continuous-wave mode at room temperature

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A large variety of gases display their fundamental molecular absorption features in the mid-infrared spectral region. Consequently, mid-infrared laser sources operating in continuous-wave (cw) mode at room temperature offering a high degree of design wavelength flexibility together with a large tunability of their emission are in high demand to address many sensitive application scenarios. Interband cascade lasers (ICLs) [1,2] combine the long upper-level lifetimes of diode lasers with the voltage-efficient cascading principle known from quantum cascade lasers (QCLs). Due to their distinctive low power consumption and low lasing threshold, ICLs are especially attractive for portable applications in the mid-infrared spectral range, such as: trace gas spectroscopy, process control and medical diagnosis [3]. While edge-emitting ICLs based on GaSb are operating in cw mode at room-temperature [2], vertical light emission from ring ICLs has up to now been limited to pulsed operation [4].

Hence, we developed a novel generation of such ring ICLs [5] tackling two shortcomings of previous devices [4] by: implementing a smaller waveguide width of ~4 µm for better suppression of higher order lateral modes in the ring cavity and realizing larger outer diameter (799 µm) rings, designed to achieve higher optical output power. In addition, an epitaxial-side down mounting scheme was employed to address the need for better heat transport from the active region for cw operation. Due to these improvements, we achieved single-mode cw operation up to a temperature of 38°C and an optical output power of more than 6 mW at 20°C.

The newly developed devices are employed in a project for trace gas analysis via the principle of photothermal interferometry. Trace gas sensing using 2f-wavelength modulation (WM) Fabry-Perot photothermal interferometry has already been demonstrated with a QCL as excitation source [6].

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